THE ECONOMIC IMPACTS AND MIGRATION PATTERNS OF THE “CREATIVE CLASS”: EVIDENCE FROM 330 METROPOLITAN STATISTICAL AREAS IN THE U.S. DURING AN AFTER-RECESSION PERIOD (2010 TO 2015)

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ABSTRACT

This thesis starts with the concept of the Creative Class proposed by Richard Florida in his book *The Rise of the Creative Class*, and examines two issues relevant to his theory: (1) the efficacy of occupational-based Creative Class to account for regional wage growth rates during the after-recession period; (2) the factors that affect the inter-region growth rates of the Creative Class for the same period. The empirical data applied in this thesis are based on the Metropolitan Statistical Area (MSA) in the United States. Two compound hypotheses are built to examine the issues with two Ordinary Least Square (OLS) regression models respectively. The T-test and F-test results from the OLS models jointly show that the factors proposed by Florida to account for the wage growth rates and the growth rates of the Creative Class in MSAs are less effective than they are expected in Florida's theory. In contrast, the general education attainment and regional economic characteristics advocated by other researchers are more important to be considered for the two growth issues.

BIOGRAPHICAL SKETCH

Yuhui Lin, who was born in Fujian Province, China, is currently a Master candidate in Regional Science major in Cornell University. Yuhui received her bachelor's degree in Urban Planning and Design from Tongji University, and used to work as an urban planner and analyst for one year in Tongji Urban Planning and Design Institution before coming to Cornell University. Her academic interests include urban and regional economics, urban development and urban analytics.

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LIST OF ABBREVIATIONS

Rise: The Rise of the Creative Class

MSA: Metropolitan Statistical Areas

OLS: Ordinary Least Square

VIF: Variance Inflation Factor

CHAPTER 1. INTRODUCTION

1.1 Richard Florida's Creative Class theory

1.1.1 Definition and uniqueness of the Creative Class

"Creative Class" is a conceptual of an occupational based population group proposed and continuously developed by Richard Florida. It was in 2002 that Richard Florida first comprehensively introduced his "Creative Class" idea, its anticipated economic impacts, and the location preferences of such a group in his book Rise (Florida 2002b).

Florida defines the term "Creative Class" to contrast with the working class (Florida 2002b, 2012). The difference between the two classes lies in their ways of work-- working class work with their physical bodies and get paid for repetitive, mostly physical work, whereas the Creative Class mainly work with their minds and get paid for their creative ideas (Florida 2014).

Besides the difference from the working class, Florida further delineates the Creative Class by dividing it into two groups based on the occupation data from the Bureau of Labor Statistics (BLS). The first group is "the core of the Creative Class", which includes occupations in science and engineering, architecture and design, education, arts, music, and entertainment. These occupations are considered to create new ideas, new technologies and new creative contents. Around this core, the Creative Class also includes a broader group of "Creative Professionals" in business and finance, law, health care, and related fields. The occupations in the broader group are also included as creative because their work engages in complex problem solving, involves a great deal of independent judgement, and requires high levels of education (Florida 2012).

In addition, Florida also distinguished the Creative Class from the widely accepted idea of human capital—people who are well-educated with at least a bachelor's degree. Florida argues that his Creative Class indicator is supplementary to, in some cases even outweighs, the conventional human capital indicator to explain regional economic growth (Florida 2002b, 2012; Florida et al. 2008). For example, occupation matters more than education to account for some economic development phenomena because educational attainment is not nuanced enough to reflect the disparity of human skills, and such a measurement can omit some critical categories like non-academically credentialed artists, musicians and creative entrepreneurs who have not earned college degrees (Florida, 2014).

1.1.2 The Creative Class and wage growth

After defining the boundary of the Creative Class and distinguishing it from the working class and conventional human capital indicator, Florida further shows in his empirical analysis results that these innovative individuals, if clustering in one region, are going to stimulate or accelerate the regional economic growth measured by wages (Florida et al. 2008). This argument is further introduced in section 2.1 in the literature review.

1.1.3 The Creative Class's location preferences (migration pattern)

Another critical part of Florida's research is the idea about location preferences of the Creative Class. Florida studies the factors that can attract and retain those creatives and proposes an idea of "3T" factors -- "Talent", "Technology" and "Tolerance" (Florida 2002b, 2012). The "Talent" is often represented by the proposition share of the Creative Class, while "Technology" is represented by the employment share of the high-tech sectors and per capita patent level, "Tolerance" is measured by the share of foreigner birth rate, gay index, and the clustering of bohemian population (Florida 2002b, 2012). Florida suggests the appearance of the "3T" factors in the base year is correlated with increase of the Creative Class in the following years (Florida 2002b, 2012). This segment of theory is fiercely debated in academic fields and will be expanded in section 2.2.

1.1.4 Brief summary for Florida's Creative Class theory

Overall, Florida's Creative Class theory has been considered as a milestone in the creative economy research since it has generated widespread conversations and debates on academic research, economic development policies and social practice (Florida et al. 2011; Florida 2014). The theory has motivated city officials and policy makers to embrace a different view toward regional economy development strategy, and also has inspired cities to invest in factors that are assumed to attract and retain the Creative Class locally.

1.2 The focused regions of Metropolitan Statistical Areas

In Florida's empirical analysis, he adopts Metropolitan Statistical Areas (MSA) rather than states or counties as his focal points. Thera are 383 MSAs across the United States in 2018. MSAs are geographical regions with relatively high population densities at their core and have integrated economic activities across entire regions. MSAs' boundaries are defined and maintained by the U.S. Office of Management and Budget (OMB) and are used by the Census Bureau and other federal government agencies for statistical purposes. Florida cares about the MSA areas because in the United States, more than 90 percent of all economic output is produced in metropolitan regions (Florida 2009).

In addition, an MSA is a suitable research unit for two reasons. First, an MSA is an integrated job market that has the right size to reflect regional economic growths and occupation changes. In comparison, States and cities are either geographically too large or too small (Drennan 2005). Second, this thesis sticks to the research units (MSA) suggested by Florida not only for the statistical merits of MSAs but also for the comparison convenience with Florida's conclusions. In fact, plenty of ensuing research built upon the Creative theory does not apply the same geographical scope, thus such analysis does not pertain directly to Florida's arguments.

1.3 An after-recession period for the Creative Class topic

The validity of Florida's arguments may vary across different economic periods. The evidence Florida originally uses to argue for economic impacts of the Creative Class is from 1990s (Florida 2002b) and the expanded revisited book in 2012 synthesizes updated data from 2000 to 2010 (Florida 2012). Based on a literature review, most of the ensuing empirical studies use evidence before the year of 2010, and some of the evidence is even before 1990s (Glaeser 2005; McGranahan and Wojan 2007; Donegan et al. 2008; Gabe et al. 2011; Möller and Tubadji 2009; Wedemeier 2012). However, the recent deep recessionary period and its aftermath forms a different economic environment across MSAs in the United States (Seman and Carroll 2017). The job markets across MSAs are unevenly impacted as a result of the economic downturn (Liu and Edwards 2015). The rough economic period during and right after the recession might show some changes to Florida's original conclusions drawn from a prosperous era.

Meanwhile, the insufficiency of after-recession research informs a necessity and opportunity to continue the Creative Class debates with current data. It is meaningful to see the economic impacts and migration patterns for a more recent period.

1.4 The most debated areas in Florida's theory

The three essential elements introduced above jointly set a foundation for this thesis. Before moving to the research questions, it is necessary to provide some background for the research questions in this thesis. As Florida himself mentioned, the Creative Class theory has motivated many ensuing studies that either criticize or support his conclusions (Florida et al. 2008; Florida 2014). Though supporters and opponents' voices sharply argue on almost every part of his theory, the most controversial parts are continuously centered on the following two questions:

(a) Does the clustering of the Creative Class critically affect regional economic development as Florida has suggested with the appearance of other important variables?

(b) What are the factors that attract and retain the Creative Class in one region?

For question (a), many scholars cast doubts on the importance priority of the Creative Class compared to human capital and other economic characteristics that are generally considered to explain the regional economic growth. They have conducted research with approximated creative indicators to examine the economic impact validity (Glaeser 2005; Rausch and Cynthia 2006; McGranahan and Wojan 2007; Donegan et al. 2008; Möller and Tubadji 2009; Gabe 2011; Wedemeier 2012; Seman and Carroll

2017). However, the majority of these studies use alternative Creative Class indicators defined by themselves, and their economic development measurements also deviate from the indicator suggested originally. The inconsistency and deviation make it difficult for these studies to directly reject or support Florida's original arguments.

For question (b), a bundle of studies has looked into the distribution patterns or locational factors attractive to the Creative Class (McGranahan and Wojan 2007; Möller and Tubadji 2009; Martin-Brelot et al. 2010; Markusen and Gadwa 2010; Wedemeier 2012). Again, approximated measurements of creativity in these studies imply less sufficient information on Florida's Creative Class, thus their arguments cannot fundamentally and directly examine the original measurements by Florida.

All in all, the intense discussions, unreached consensus, heterogeneous indicators and omitted time periods in this field jointly motivate a study that inherits Florida's definition of the Creative Class but uses recent evidence from MSAs in the United States. With that being said, the following section is going to unfold the research questions in this thesis.

1.5 Thesis research questions

The overall purpose of the research questions is to test parts of Florida's Creative Class theory by narrowing it down to two questions based on the intensively debated questions in (a) and (b). The two questions stick to Florida's original definition of the Creative Class, and at the same time, focus on the Metropolitan Statistical Areas during the after-recession period (2010-2015) in the United States. Furthermore, two hypotheses are built respectively based on the thesis questions.

Question 1: during the after-recession period, what impacts does the Creative Class have on regional wage growth in MSAs in the United State, controlling other important factors such as the education attainment and economic characteristics?

Null hypothesis 1: the percentage of Creative Class in MSAs does not explain the variance of regional wage growth, along with conventional education attainment and other economic characteristic variables in the model.

Alternative hypothesis 1: the percentage of the Creative Class in MSAs does explain the variance of regional wage growth, with appearance of the education attainment and other economic characteristic variables in the model.

Question 2: during the after-recession period, what are the inter-region migration patterns for the Creative Class (convergence or divergence), and what factors are significant to attract and retain the Creative Class?

Null hypothesis 2: "3T" plus "place-making" factors defined by Richard Florida do not explain the growth rate of the Creative Class across MSAs, controlling the education attainment and other economic characteristics variables in the model.

Alternative hypothesis 2: "3T" plus "place-making" factors defined by Richard Florida do explain the growth rate of the Creative Class across MSAs, controlling the education attainment and other economic characteristics variables in the model.

CHAPER 2. LITERATURE REVIEW

The literature review is divided into two parts (section 2.1 and 2.2) according to the research questions 1 and 2 in the introduction chapter. Section 2.1 introduces Florida's emphasis on the Creative Class's economic contributions, and other relevant studies that discuss economic impacts of the creatives as well as other controlling variables. Section 2.2 introduces studies looking into migration patterns of the creative population and factors that attract and retain creative populations.

Here, the noun "the creative population" and "the creatives" are used to describe the research content if the studies use alternative indicators or categories to approximate Florida's original Creative

Class measurement. The term “Creative Class” will be used only if the research applies the same measurement as Florida suggested.

2.1 Literature Review for Question 1 and Hypothesis 1

2.1.1 The importance of the Creative Class to account for regional economic growth

Based on Florida, the clustering of the Creative Class is considered to positively impact regional productivity, thus to increase the nominal wage growth for a region (Florida 2002b; Gabe 2007; Florida et al. 2008; Florida 2012; Florida 2014). This wage-measured economic growth from the clustering of the Creative Class is nested inside Florida’s big idea that regional economic growth generally is driven by the locational choices of creative people (Florida 2002b, 2014). Some scholars, though researching with diversified methodology and various data contexts, have drawn similar conclusions that somehow support Florida’s big idea (McGranahan and Wojan 2007; Möller and Tubadji 2009; Gabe 2011; Wedemeier 2012).

2.1.2 Debate on the positive economic impacts of the Creative Class

However, many scholars cast doubt on the efficacy of the Creative Class’s economic impacts and argue that conventional human capital (education attainment) and other economic characteristics of a region are more important as determinants for regional economic growth (Glaeser 2005; Rausch and Negrey 2006; Donegan et al. 2008). These studies apply various indicators to measure economic growth, such as population growth (Glaser 2005), gross metropolitan product per capita (Rausch and Negrey 2006), per capita income growth (Donegan et al. 2008). For this thesis, economic growth is represented by the regional wage growth emphasized by Florida.

Meanwhile, the economic characteristics being discussed below include total employment, percentage of foreign-born population, percentage of private sector employment, percentage of self-employed population, percentage of manufacturing employment, percentage of agriculture employment, median house values, median house value changes, and female labor force participation rate. These economic characteristic indicators plus education attainments are generally used as important independent variables to explain regional economic growth, especially for wage growth. The following paragraphs provide detailed discussion on the dependent and the independent variables mentioned above.

Wage growth

Average wage level reflects the regional productivity and is the basis for the study of agglomeration economies and to evaluate economic growth (Glaeser 2007). Growth of earned wage (including salary and wage) is a dependent variable that better correlates with the Creative Class's clustering since wages are more place dependent than incomes (Gabe 2007; Florida et al. 2008; Wedemeier 2012). Because the components of income, such as dividends and interests, are reported in the place received rather than the place generating that factor income (Drennan 2005).

In this thesis, the growth rate of the median wage (wage plus salary) for both male and female from 2010 to 2015 in MSA level is used as a dependent variable to represent regional economic growth during the after-recession period. The formula for this dependent variable is *(ln (median wage 2015) – ln (median wage 2010))*, and the dependent variable is denoted as "LnMedEarChange"[1].

Percentage of the Creative Class among all employment

The clustering of the Creative Class influences regional economic activities by the channel of wages because the Creatives agglomeration can raise regional productivity (Florida et al. 2008; Wedemeier 2012). Some studies that show the Creative Class's positive impacts on income per capita growths can also strengthen Florida's argument, given that wages are highly correlated with incomes and represent two thirds of incomes in the U.S. (Drennan 2005; Donegan et al. 2008).

In this thesis, this variable is measured by the percentage of the Creative Class (including both male and female) among total employments in the base year 2010 (denoted as "PCC10"), and this key variable is expected to have a positive coefficient to the wage growth rate.

[1] In the ACS, the original name of this variable is "median earnings (dollars)", which include earned wages and salaries. For a consistency purpose, this thesis uses "wage" to represent "earnings".

Percentage of population with at least A Bachelor's degree

Many scholars involved in the discussion cast doubt on the economic impacts of Florida's subjectively selected occupational indicator, and they consider education attainment to be more valid to account for regional economic growth (Glaeser 2005; Rausch and Negrey 2006; Donegan et al. 2008; Wedemeier 2012). Generally, regional education attainment reflects the human capital externality that drives economic development (Lucas, 1988). Glaeser argues that human capital measured by college education attainment is good enough to predict urban success because the population with at least a bachelor's degree contains the most skillful individuals working at high skilled industries (Glaeser 2005). Wedemeier also points out the definition of the "Creative Class" is a quasi-arbitrary selection compared to clearly defined education attainment (Wedemeier 2012).

In this thesis, the education attainment is measured by the percentage of population over 25 with a bachelor's degree or higher in 2010 (denoted as "PerEdu10"). The expected sign for education attainment's coefficient in the model is positive.

Total Population

Total population in a region is an indicator to reflect the type of external returns to scale, and it influences regional economic growth indirectly (Jacobs 1961; Glaeser 2007; Florida et al. 2008). Regions with large total population size are more diversified and enjoy the urbanization economies of scale, while regions with relatively small population are more likely to have specialization economies of scale (Jacobs 1961). External returns to scale dominant in a region affect its wage growth rates, with urbanization economies of scale promoting economic development more (Jacobs 1961). Also, a wage study by Drennan (2005) reveals that population size has a positive correlation with metropolitan real wage.

In this thesis, total population is used to control the various external returns to scale for different MSAs. Both the linear and polynomial functional forms will be examined. The linear term (denoted as "LnTotPop10") is expected to positively associate with the wage growth rate.

Percentage of foreign-born population

Foreign born population is an indicator to measure the tolerance level of a region (Florida 2002b, 2012). High tolerance regions are more diversified, more likely to enjoy the positive externalities with their urbanization economies of scale, and thus observe higher wage growth rates. Also, a larger foreign-born population increases regional productivity because it brings in complementary skills to the native population, and thus generates knowledge spillovers regionally (Ottaviano and Peri 2005). Moreover, places with different levels of foreign-born population suffer differently from the recessionary period, which makes it necessary to control this variable for regional wage growth for the study period.

Given the positive association between the shares of foreign-born population and tolerance of regions, the connection between foreign-born population and external returns to scale, this variable (denoted as "FBP0610") is expected to have a positive coefficient when accounting for regional wage growth rate.

Percentage of population over 65-year-old

The age structure of a region is also a controlling variable to account for the regional economic development (McGranahan and Wojan 2007). In their study, the percentage of population over 64-year-old is negatively associated with regional employment growth.

Considering the data availability, the percentage of population over 65-year-old (denoted as "Perover65") is included as a controlling variable to account for regional wage growth rate, and the expected coefficient sign is negative.

Percentage of private sector employment

Free market economists propose that a high percentage of private sector employment tends to create more jobs because firms react to consumer preferences and market trends, and make their employees work in domains of high demand (Pettinger 2017). Therefore, employment shares in public and private sectors also are factors to influence economic development regionally. A high share of employment working in the private sector generally means high privatization rate and free market competence that commonly tend to raise wage levels.

Therefore, the percentage of private sector employment in 2010 in MSA level (denoted as "PerPrivaSect10") is an explanatory variable to explain regional wage growth rate and is expected to have a positive coefficient sign.

Percentage of self-employment population

Percentage of self-employment is expected to increase during the period of recessions due to its attractiveness as an alternative to unemployment. A high percentage of self-employment indicates plausible transition from unemployment to self-employment (Beckhusen 2014). Policy-makers also consider self-employment as a way to boost the income of their residents (Shane 2014). For the after-recession period, it is reasonable to assume a high percentage of self-employment is a signal of regional economic resilience that positively affects the ensuing regional wage growth. The higher is the self-employment rate, the more resilient is the economy to the unemployment shock during economic downturn, and finally the more robust wage growth during the after-recession period.

Therefore, the percentage of self-employment population in 2010 in MSA level (denoted as "PerSelfEp10") is an explanatory variable for ensuing regional wage growth rate and the expected coefficient sign is positive.

Percentage of manufacturing employment
(Percentage of agriculture employment)

The industry mix of a region essentially affects its economic growth rate (Vohra 1997; McGranahan and Wojan 2007; Donegan et al. 2008). The percentage of manufacturing employment and the percentage of agriculture employment are typical industry-mix variables to model the economic structure and growth rate of a region (McGranahan and Wojan 2007; Donegan et al. 2008).

It is a common sense that agriculture dominant regions grow more slowly than regions with high share of service or information industry. However, during the after-recession period, regions with a high percentage of agriculture may have suffered less from the economic crisis and have relative moderate growths since food manufacturing is empirically shown to be recession-proof (Ramesha 2019). According to a report by U.S. Department of Agriculture, US agriculture was better positioned and less affected than most US industries during the recession, and it is well positioned to do well during the recovering period (Haris 2012). Therefore, it is plausible to expect the percentage of agriculture employment (denoted as "LnPerAgri10") is positively associated with regional economic growth.

As for manufacturing employment share (denoted as "PerManufa10"), some studies show negative correlation between this variable and regional economic growth (McGranahan and Wojan 2007; Donegan et al. 2008), and no recession-proof evidence has been proposed. Thus, this thesis assumes a negative sign for this controlling variable.

Median house value

Regional wage difference is largely explained by local attributes such as rent or house values (Roback 1982). Median house value in the base year is a necessary variable to control the wage growth rate in a region. On one hand, housing price calibrated by the median house value are a measurement of the local cost of living, which is highly correlated with local wage level and its growth rate—generally, high housing price need to be compensated with high wage levels (Roback 1982; So et al. 2001). On the other hand, the regions with different median house values are impacted from the recession differently, and this economic disparity should also be controlled in the model.

In this thesis, the median house value (denoted as "LnMHV10") is expected to have a negative sign against wage growth rate. The main reason is that regions with initial high housing prices, such as New York MSA and Los Angeles MSA should have high wage levels to compensate high cost of livings. The large denominators in these regions' wage growth rates mathematically contribute to the lower values.

Median earnings (wages) in base year

The initial median earnings (median wages for male and female) in the base year should be controlled in accounting for the ensuing wage growth because each region's endowed productivity level is spiky. From the mathematical perspective, the expected coefficient sign for median household earnings are negative for the wage growth rate because the wage growth rate between t and (t+n) period is calculated as ((median earnings $_{(t+n)}$ /median earnings $_{t}$) – 1).

Average female labor force participation rate

Besides the industry mix variables, the share of female workers in the labor market is widely considered as a variable to describe economic characteristic of a region, which is associated with regional wage growth (Drennan 2005; Weinstein 2017). Drennan (2005) proposes the share of female labors should be controlled for to study the wage convergence versus divergence trends among MSAs in the United States. Weinstein's study (2017) shows the percentage of female labors is positively correlated with regional wage growth.

In this thesis, an average female labor force participation rate between 2006 and 2010 (denoted as "AveFLFPR0610") is computed as a variable to account for the regional wage growth rate, and the expected coefficient sign for this variable is positive.

Change of median house value

Similar to the self-employment variable, change of median house value is also an indicator to reflect the economic resilience of an MSA economy to the shock of the recession. Abel and Deitz (2010) conduct a study about the boom-bust situation of metropolitan home prices. In their study, the metropolitan areas went through housing price booms before 2006 suffered from severe busts after the peak.

Inspired by this study, the change of median house value between 2006 and 2010 is included as a controlling variable to account for the economic performance before the base year 2010. If an MSA observed an increase in its median house value from 2006 to 2010, it either had less of a bubble in the housing market or was less impacted during the recession. It is reasonable to expect the less vulnerable MSAs would economically perform better during the recovering period.

Therefore, this variable is calculated as *((median house value in 2010 – median house value in 2010)/median house value in 2006)* and is denoted as "MHVChange0610". It is expected to positively correlate with the wage growth rate after 2010.

2.1.3 Periodic Summary of Literature Review for Question One

The former studies on the economic impacts of the Creative Class vary across their geographic contexts, study periods, and deployed measurements. The literature review for question one incorporates ideas from these former studies and also refers to other conventional wage growth research. With the economic characteristics variables plus education attainment indicators introduced above, whether the Creative Class is still positive associated with regional wage growth rate during the after-recession period remains unsolved and would be tested in chapter five.

2.2 Literature Review for Question 2 and Hypothesis 2

2.2.1 The Trend of the Creative Population's Migration

Before 2010, the migration pattern of the creative people is considered to be divergent—the disparities of human capital were diverging, and the gap became larger and more pronounced across regions in the United States (Berry and Glaeser 2005; Florida et al. 2008). However, the Great Recession hit the U.S. economy unprecedentedly and affected job markets differently across metropolitan areas (Liu and Edwards 2015). This variety may stimulate new trends for the spatial distribution of the Creative Class.

Under the assumed divergence trend before 2010, Florida proposes an idea that the places with good creative population climates are anchors to attract more members of the Creative Class (Florida 2002b, 2012). In the post-manufacturing era, talent and creative people have become crucially important, the quests for these population in knowledge-intensive regions are larger than that in less creative places (Florida 2002b; Florida et al. 2008; Florida 2012). With that being said, Florida implies that the initial value of the creative population endowed in a region is a determinant of its following increasing rate.

However, both Florida himself and some follow-up researchers lack systematic empirical examinations to prove the divergent migration trends for the Creative Class. Florida does not provide any well-documented models to confirm this spatial self-reinforcing pattern. Also, Florida's idea is not tenable if we consider the growth rate of the Creative Class mathematically (the Creative Class share $_{(t+n)}$/ the Creative Class share$_{(t)}$ - 1)—the places with a higher initial percentage of the Creative Class are more likely to have a lower growth rate except for serious divergences.

Furthermore, some studies based on other countries or non-metropolitan areas in U.S. have somehow challenged Florida's idea of divergence (McGranahan and Wojan 2007; Möller and Tubadji 2009; Martin-Brelot et al. 2010; Wedemeier 2012). The research by McGranahan and Wojan (2007) examines the spatial migration trend between 1990 and 2000 and reveals that the creative population in the base year negatively associates with future growth rate. Hansen and Niedomysl (2008) conduct a case study based on Sweden and also imply a convergence pattern. A more recent research by Wedemeier (2012) based on German cities also argues against Florida by revealing a convergence trend of its self-defined creative group. Put in a nutshell, many studies find opposite conclusions against the divergence trend proposed by Berry and Glaeser (2005) and Florida et al (2008).

Different conclusions with distinct time and space contexts have been drawn in this topic, but current evidence from the United States is still missing. Questions still remain to be answered for the after-recession U.S.: does the spatial pattern of the Creative Class show a convergence or a divergence trend during this special period? What are the important factors that influence the Creative Class's migration pattern?

As observed by some researchers, there is very limited quantitative research to answer these compound questions worldwide (Hansen and Niedomysl 2008; Martin-Brelot et al. 2010; King 2011), and studies based on MSAs in the U.S. is even more insufficient. Therefore, the following paragraphs elaborate upon some similar studies, and the discussion will set a foundation for the second model of this thesis.

2.2.2 Debate on Factors That Influence Migration Patterns of the Creative Population

Under his divergence assumption, Florida proposes a “3T” and place-making framework to account for what sorts of places are favored by the Creative Class—the places endowed with talents, technology and tolerance, as well as places that have a beautiful and vibrant physical environment (Florida 2002b, 2012)[2].

Many scholars performing subsequent studies show that 3T-relevant factors only have marginal effects or are even not significant to explain the migration patterns of the Creative Class, with the appearance of other important variables. By these studies, the Creative Class chooses their destination more to do with regions’ economic perspectives, such as industry mix, cost of living, general education level and so on (Rausch and Cynthia 2006; Donegan et al. 2008; Martin-Brelot et al. 2010, Wedemeier 2012).

However, King (2011) summarizes that the influential powers are uneven among the 3T factors. Some studies empirically prove that the agglomerations of artists and bohemians, which belong to the category of “talent”, are positively correlated with the regional creatives growth rate in some cases (McGranahan and Wojan 2007; Möller and Tubadji 2009; Markusen and Gadwa 2010; Wedemeier 2012). Also, places endowed with a large high-tech population size (represent for “technology”) are certified to have higher growth rates of the creative population for certain circumstances (Möller and Tubadji 2009; King 2011; Wedemeier 2012). Moreover, Florida himself confirms that the appealing effect of the “tolerance” is weaker compared to the other two “T” (Florida 2002b, 2014).

As for the place-making factors, Markusen and Gadwa’s study (2010) supports the intra-city level positive association between the quality of place and the growth rate of the creative population. Whereas McGranahan and Wojan (2007) find most of the physical environment indicators at inter-region level are

[2] Detailed definition of 3T factors is provided in appendix

not significant to account for creatives' growth. Therefore, the second question and hypothesis are found necessary to test Florida's idea of the migration patterns and factors causing such a pattern, by incorporating refined representative "3T" factor, "place-making" factors, and other important controlling factors. Following paragraphs expand on the dependent variable, and independent variables that either come from the "3T", "place-making" or the important controlling group.

Percentage change of the Creative Class

In Florida's theory, the growth rate of the Creative Class is determined by the initial clustering situation of the Creatives in a metro area (Florida 2002b, 2012). This argument emphasizes the ensuing effects by spiky human capital endowments across regions. Some following studies also use this indicator as a dependent variable to measure the creative population's location preferences (McGranahan and Wojan 2007; Möller and Tubadji 2009; Martin-Brelot et al. 2010; Wedemeier 2012).

In this thesis, the change of the Creative Class with a natural log transformation (denoted as "LnCCchange") is computed to measure the growth rate of such creative population in each MSA. The following paragraphs introduce how each expected independent variable is associated with this growth rate.

The percentage of the creative population

The percentage of the creative population (including all genders) is an indicator for the "talent" category within 3T framework. Florida qualitatively argues that the initial value of the Creative Class in one region is an important determinant for its future growth. He qualitatively argues for a self-reinforcing pattern of such a growth (Florida 2014).

In contrast, some research reveals different implications where the significance of the initial creative population share is rejected or evidently outweighed by other variables (McGranahan and Wojan 2007; Möller & Tubadji 2009; Wedemeier 2012). For example, the empirical result by Wedemeier (2012) shows the initial share of the Creative Class retains a negative effect on the following growth rate, and thus implies a convergence trend between regions.

It is worth testing how the initial percentage of the Creative Class affects the following years' growth rate in terms of sign and magnitude, with recent evidence from the United States. This key variable (denoted as "PCC10") is expected to have a negative coefficient given its mathematical formulation (the growth rate equals to *ln (CC15)-ln (CC10)*)—the larger the base year value is, the smaller the growth rate is.

The percentage of employment in art relevant industries

Employment in the art industry also falls into "talent" category within 3T framework, it is an approximated indicator for "Bohemian" proposed by Florida (2002a, 2002b, 2012). Artists are producers of new ideas, workforces doing art-relevant jobs are considered to have creativity power and place making ability that jointly attract the Creative Class (Florida 2002b, 2004, 2012).

Some scholars support this argument. McGranahan and Wojan (2007) shows the employment share in the recreation industry is positively correlated with growth rates of the creative population. Wedemeier (2012) confirms a positive correlation between creative population growth and the initial agglomeration of artists. Markusen and Gadwa (2010) more comprehensively summarizes the impact of art and good-quality place on retaining and attracting talent population. Though Markusen and Gadwa's research is more focused on intra-city level rather than metropolitan level, her conclusion still share some common insights with Florida's idea.

In this thesis, the percentage of employment in art-relevant industries (denoted as "PerArtIn10") in the base year is expected to have a positive effect on the dependent variable.

The percentage of high-tech industry employment

(Patent per capita)

The percentage of high-tech industry employment and patents per capita are both technology indices that are nested in the "3T" indicators. They represent the technology development level of a region and are considered to be positive factors that appeal to the Creative Class (Florida 2002b, 2012). Overall, significant positive correlations between the technology indicators and the increasing of the creatives are supported by many studies (Florida 2002b; Donegan et al. 2008; Möller and Tubadji 2009; Wedemeier 2012). However, Glaeser (2005) shows the patents per capita is insignificant to explain the growth.

In fact, the technology index in Florida's theory is composed of three parts: the Milken Institute's Tech-Pole Index, which is a measure of high-tech industry employment, plus two measures of innovation capability, patents per capita and average annual patent growth (Florida 2002b; 2012). Given the patent growth rate and patent per capita somehow describe one thing, average annual patent growth is excluded in this thesis. The two remaining variables (denoted as "PerHighTech10" and "LnPatentPC10") are expected to have positive effects on the growth rate of the creative population. But it is worth mentioning that the coefficient for patents per capita is less supported to be significant compared to the high-tech employment.

Percentage of foreign-born population

(Percentage of population voting for Democratic Party)

"Tolerance" is also a grouped indicator that measures the diversity, openness and tolerance of a region. High percentage of foreign-born population is assumed to reflect the region's alignment with the three features that are appealing to the Creative Class (Florida 2002b). From Florida's perspective, Gay-index and Bohemian-index are also measurements for the regional tolerance. However, there are three reasons that explain why these two indexes are not included and replaced with the percentage of Democratic votes. First, Gay-index can be hardly measured with accuracy given it is highly private and personal information. Second, Bohemian-index is highly correlated with art industry employment introduced above (Möller and Tubadji 2009). Third, the voting statistic is more accurately recorded and can also reveal the tolerance level of a region.

Therefore, the average percentage of foreign-born population before the base year (denoted as "PerFBP0610") and percentage of Democratic votes during 2008 election (denoted as "PerVoteDe08") are included as “tolerance” indicators, and they are both expected to have positive coefficients for the regional creatives’ growth.

Water and land ratio of a region

Percentage of water area is commonly used to describe the basic environment endowment in one region and considered as place-making indicator. Water areas are somehow attached with vibrant and diversified urban activities, because higher water land ratio may indicate appearance of waterfront and harbor spaces that can host many attracting leisure and economic activities. For example, many pier spaces in New York City now have been retrofitted into fancy and cool bars, those places are highly favored by young and creative people and serve as commonly acknowledged public goods for the city. McGranahan and Wojan (2007) incorporates the percentage of water area in MSA level as a determinant for the growth rate of the creative population in 1990s and shows a positive sign for water area percentage.

However, this thesis models the growth rate of the Creative Class in an entirely different economy environment—recovering period rather than the prosperous era in 1990s. The preference of water might be outweighed by other factors, because by preliminary map, the fast-growing regions in terms of the Creative Class are hinterland MSAs. Therefore, the sign of this variable (denoted as “lnWLRatio”) is expected to be positive based on former studies but negative based on the recent evidence.

Percentage of commuting by public transit

The prevalence of public transit infrastructure is a comprehensive variable to measure the built environment of a region, thus can be used as a place-making indicator. High prevalence of public transit in a region generally implies more compact and denser built environment. Influenced by Jane Jacobs’ theory (1961), Florida proposes the Creative Class prefers compact urban environment because their necessity for face to face communication during idea sharing (Florida 2002b, 2012).

However, given that the direct data to measure the physical construction of public transit is unavailable in MSA level, an alternative data set of regional commuting structure is used here to approximate the development level of public transit infrastructure. Therefore, the percentage of commuting by public transit (denoted as "LnPerPT") is adopted and is expected to have a positive effect.

Population density

Florida is influenced by Jacobs's idea that creative activities need a compact and dense physical environment (Jacobs 1961; Florida 2002b; 2012). On one hand, higher population density implies a larger possibility for a region to have diversified and integrated economic activities. A region is more likely to enjoy the "Jane Jacobs externalities" if it is densely populated (Florida 2002b, 2012, 2014). On the other hand, high density population is an alternative indicator to reflect the compact physical environment of a metropolitan area given that the direct measurement for built environment is unavailable.

With that being said, the creative population would trek to regions with high population density. This density variable (denoted as "LnPopDensity10") is expected to have a positive coefficient for creatives' growth rate.

Total Population

The total population of a region reflects the size and diversity of its local labor market, which are focal points for job seekers including the creatives. One following research to Florida's topic uses population size as a controlling variable in the model, and reveals metropolitan areas with more population are likely to undergo growth due to economies of agglomeration (Donegan et al. 2008). Thus, the initial value of the total population should be included in the model, because it's a good indicator to measure the labor market size and job opportunities.

For this thesis, both linear and polynomial functional forms for total population will be examined. The expected coefficient for the linear term (denoted as "LnTotPop10") is expected to be positive based on former empirical studies.

Percentage of population with at least a bachelor's degree

Möller and Tubadji's model (2009) shows the share of high-skilled population (people with a bachelor's degree) is robust to explain the creative sector growth. Wedemeier (2012) also points out the creative population care more about an overall knowledge externality in one region rather than the agglomeration of its peers. Therefore, the percentage of population with at least a bachelor's degree in the 2010 (denoted as "PerEdu10") is expected to positively associate with the dependent variable in this model.

Percentage of black population

The racial composition of a region is a common control variable for relevant studies. Both White, Black and Hispanic proportions have been examined in different studies, but all estimated parameters are revealed to be insignificant (McGranahan and Wojan 2007; Gabe 2011). For this thesis, the percentage of lack population (denoted as "PerBla10") is included as a representative controlling variable, but it is expected to be insignificant as former studies' results.

Percentage of population over 65-year-old

The age structure of a region is also a controlling variable to account for the growth rate of the Creative Class (McGranahan and Wojan 2007; Gabe 2011). For example, McGranahan and Wojan (2007) shows that a high percentage of population over 64-year-old makes a place less attractive for both creative workers or general job seekers.

Therefore, the percentage of population over 65-year-old (denoted as "Perover65") is a necessary controlling variable to reflect the regional demographic information, and the expected coefficient for this variable is negative for the growth rate of the Creative Class.

Average median January temperature

Median January temperature is a common measurement to assess the urban amenities across regions (Glaeser 2007; McGranahan and Wojan 2007; McGranahan 1999). It indirectly reflects some innate geographic advantages of certain regions, such as proximity to ocean, proximity to lakes, and warmer climate. Among those innate advantages, warmth is considered as an important natural amenity that plays a role to influence people's location choices. People generally prefer warmer places and need to get paid more to work in colder places (Roback 1982; Glaeser 2007; McGranahan and Wojan 2007).

The expected coefficient sign of average median January temperature over 100 years (denoted as "MeanJanTemp100Y") for the growth of the Creative Class is positive, indicating that warmer places are going to observe faster creative population growth.

Cost of living index

Plenty of research in urban economics has studied the cost of living as a reflection of regional affordability and urban amenity level, and furthermore, as a determinant for locational attractiveness (Rosen 1979; Roback 1988). Rosen (1979) and Roback (1988) both imply that high nominal wage level may compensate for higher rent in one region for spatial equilibrium. Glaeser (2007) shows that high wages are offset by high housing prices, and this compensation highly influences people's settlement locations. Albouy and Lue (2015) also take local rents and wages levels as two variables to examine the livability of places within and across regions.

Thus, the cost of living variable in this thesis is constructed a fraction (annual median earnings / annual median gross rent for housing). This indicator delineates the relative level of wages compared to the housing cost. In one way, the higher value may indicate the affordability of a region, whereas it can also imply the regional urban amenities is poorer based on Rosen and Roback's theory. Considering the preliminary sorted value, this thesis explains better from the perspective of urban amenity level[3]. Thus, the cost of living (denoted as "COL10") is included and expected to have a negative coefficient sign.

[3] Detailed sorted value of cost of living variable is provided in the appendix.

Median house value

Regional housing price is an important factor to consider when people make their migration decision (Roback 1982, 1988; Albouy and Lue 2015). Generally, affordable housing is a big appealing factor to attract general population as well as the Creative Class. However, extremely low and high housing prices might imply a certain extent of disamenities regionally. For example, excessive high housing prices indicates over-population and all sorts of attached problems, while excessive low housing prices might imply regional shrinkage or severe population lose.

Thus, a polynomial functional form for median house value is suggested to account for certain population growth based on urban economics theory (O'sullivan 2019). With such a polynomial form, the expected coefficient sign for the linear term ("LnMHV10") is positive while negative for the quadratic one ("LnMHV10_2").

Percentage of private sector employment

As it is introduced before in section 2.1.2, high percentage of private sector employment implies higher competition between firms regionally. Such a competitive environment, combined with urbanization economies of scale, is a healthy ground for cities to grow (Jacobs 1961, 1970), High prevalence of private sector is considered to motivate production innovations in a region (Jacobs 1961, 1970; Glaeser 2007). Therefore, it is reasonable to expect the creative population would prefer regions with higher shares of private firms (denoted as "PerPrivaSect10").

Change of unemployment rate

The change of the unemployment rate is also a determinant to explain inter-region labor force migration (Seman and Carrol 2017). The growth rates of overall jobs or certain occupations are correlated with the dynamism of job market before the base year. Seman and Carrol (2017) include the employment rate between 2007 and 2009 as a control variable to model the growth rate of creative economy. Their case study in Texas shows that the recent recession has regionally different impacts on unemployment rates, creative job growths, and the impacts can extend to the after-recession era.

Therefore, the change of unemployment rate (denoted as "CUnEmRate0710") before the base year is included as a controlling variable to account for diversified regional vulnerabilities to the recession, which set grounds for ensuing creative population growth. The variable is calculated as *((Unemployment rate 2010 – Unemployment rate 2007)/Unemployment rate 2007).* The expected coefficient sign of this variable's coefficient is negative since regions with increases in unemployment rates are more vulnerable to economic crisis shocks, and thus less favored by the creatives.

2.2.3 Periodic Summary of Literature Review for Question Two

With similar studies referred to above, migration patterns and appealing factors for the Creative Class during the after-recession U.S. remain unsettled since no research is directly applied to this special case. Therefore, the conclusions on each factor drawn from former studies might be opposite and controversial to current evidence. However, these studies are still informative to the extent of variable selection.

CHAPER 3. METHODOLOGY DISCUSSION

Two models are built for this thesis to shed light on the research questions. The two models share the similar structures even though they test different aspects of Florida's original theory. The two models both apply Ordinary-Least-Square (OLS) estimators, and construct cross-sectional models with predetermined variables. Also, both of them are tested for spatial autocorrelations. The following paragraphs elaborate on three essential aspects of the methodology in this thesis.

3.1 A Choice of Ordinary Least Square

Based on Gauss-Markov Theorem, the Ordinary Least Square estimator is the minimum variance estimator compared with other linear unbiased estimators. Given seven classical assumptions, the OLS coefficient estimator is unbiased, consistent, has the minimum variance, and normally distributed (Studenmund 2010).

Many former studies apply OLS estimators to examine the different impacts of the creative population or to examine the factors that attract the creatives (Glaeser 2005; McGranahan and Wojan 2007; Donegan et al. 2008; Gabe 2011). Thus, OLS regression model is an appropriate method for this thesis if the seven assumptions are met.

Several tests will be applied to diagnose whether the assumptions of OLS hold in the two models. They are omitted variable test, variance inflation factor test, and residuals independence test. Also, if heteroskedasticity problem is found, robust standard error is used to estimate the coefficients as a remedy strategy.

All independent variables will be specified with correct functional forms for elasticity, and to obtain linear relationships with the dependent variable. The detailed functional forms will be provided in the data discussion chapter.

3.2 Predetermined variables

Most of the referenced studies apply the basic OLS estimator. There are also some studies including 2-stage or reduced-form OLS to solve endogenous-variable problems (Shapiro 2005; McGranahan and Wojan). Shapiro (2005) use land-grant university as an instrumental variable for the share of human capital when modeling regional employment growth. McGranahan and Wojan (2007) use the growth of creative population to explain the growth of total population for the same period in their original regression, and then apply a reduced-form OLS estimator which exclude the endogenous variables in the right-hand side of the equation.

However, in this thesis, all explanatory variables are designed with the base-year data or with data even before 2010 base year (for example, the median house value change from 2006 to 2010). Such a design will help to reduce the influence of endogeneity. Finally, combined with post-regression diagnoses, it turns out that residuals from the two models are not correlated with explanatory variables, thus the 2-stage or reduced-form OLS estimators are not necessary for this study.

3.3 A Cross-Sectional Analysis with predetermined variables

Cross sectional regression is applied given that the nature of the research questions is to exam how the explanatory variables, measured in the base year or even before, impact the ensuing dependent variables. Many former studies also apply cross-sectional methods to study either economic impacts or migration patterns of the creative population under inter-region contexts (Glaeser 2005; McGranahan and Wojan 2007; Florida et al. 2008; Donegan et al. 2008; Gabe 2011; Wedemeier 2012).

3.4 Diagnosis of Spatial Autocorrelation

The residuals from the anticipated models will take spatial autocorrelation test, because spatial dependence of the residuals may imply an omitted variable problem, and indicate the model needs omitted variables or a spatial error term. In this thesis, Global Moran's I is applied to detect whether the residuals are spatially autocorrelated in a global level. The weighting scheme of "Contiguity, Edges and Corners" and "Inverse Distance" are both applied to calculate the Global Moran's I, since these two weighting schemes are the most common choices for demographic studies (Schmidt, 2019).

CHAPER 4. DATA DISCUSSION

This chapter is divided into two sections to introduce variables for the two expected models. First, 4.1 introduces variables and data formulas for model I, which answers the economic impact question. Second, 4.2 introduces variables and data formulas for model II to answer the migration pattern question. All data sources are provided in the appendix. Statistical summaries for the two models are also provided in this chapter. For variables in both sections, their abbreviated terms correspond to the variables' notations introduced in chapter two. Importantly, all "Ln" signs indicate the variables have taken natural log transformation.

4.1 Data for Question One and Model I

Data Introduction

Table 1 Variable introduction for model I[4]

Category	Variable	Meaning or formula	Expected Sign
Dependent variable	LnMedEarChange	Log transformed growth rate of nominal median wages for all genders (ln (median wage 15)- ln (median wage 10))	NA
Key variable	PCC10	Percentage of the Creative Class among all employments in 2010	+
Controlling variable	PerEdu10	The percentage of the population over 25 with at least one bachelor's degree or higher in 2010	+
Controlling variable	LnTotPop10	Log transformed total population in 2010	+
Controlling variable	PerFBP0610	5-year averaged percentage of foreign-born people (from 2006 to 2010)	+
Controlling variable	Perover65	Percentage of population over 65-year-old	-
Controlling variable	PerPrivaSect10	Percentage of private sector employment in 2010	+
Controlling variable	PerSelfEp10	Percentage of self-employed population in 2010	+
Controlling variable	PerManufa10	Percentage of employment in manufacturing industry in 2010	-

[4] Detailed data sources are provided in appendix

Controlling variable	LnPerAgri10	Log transformed percentage of employment in agriculture industry in 2010	+
Controlling variable	LnMHV10	Log transformed median house value in 2010	-
Controlling variable	MedEar10	Nominal median household earnings (wages and salaries) in 2010	-
Controlling variable	AveFLFPR0610	5-year averaged female labor force participation rate from 2006 to 2010	+
Controlling variable	MHVChange0610	Growth rate of median house value from 2006 to 2010: ((MHV10-MHV06)/MHV06)	+

Table 2 Statistical summary for model I

Variable	Obs	Mean	Std. Dev.	Min	Max
LnMedWChange	330	.0729442	.065184	-.1309028	.391421
PCC10	330	27.1442	4.675922	13.27607	45.48859
PerEdu10	330	25.32212	8.034664	10.9	57.5
LnTotPop10	330	5.520566	.4662259	4.873774	7.276921
PerFBP0610	330	6.051435	3.741903	.3376278	20.25316
Perover65	330	13.27545	3.207946	6.4	34.1
PerPrivaS~10	330	77.46879	5.154273	60.5	86.6
PerSelfEp10	330	6.251818	1.511842	3.5	12.7
PerManufa10	330	11.71424	5.756704	2	39.1
LnPerAgri10	330	.4594034	.8648032	-1.609438	2.833213
LnMHV10	330	11.9554	.3662729	11.20095	13.35569
MedEar10	330	29704.75	3926.291	20038	47610
AveFLFPR0610	330	59.00809	4.707972	43.08315	72.17805
MHVChan~0610	330	3.642472	18.12872	-59.3376	71.98177

Table 3 Correlation Matrix for model I

	LnMedW~e	PCC10	PerEdu10	LnTotP~0	PerFBP~0	Perov~65	PerP~t10	PerS~p10	PerM~a10	LnPer~10	LnMHV10	MedEar10	Ave~0610	MHVCha~0
LnMedWChange	1.0000													
PCC10	-0.0682	1.0000												
PerEdu10	0.0062	0.7342	1.0000											
LnTotPop10	-0.0670	0.3892	0.3655	1.0000										
PerFBP0610	0.1020	-0.3715	-0.3735	-0.7585	1.0000									
Perover65	-0.0026	-0.3547	-0.2665	-0.1999	0.2110	1.0000								
PerPrivaS~10	0.1974	-0.2863	-0.1558	0.2333	-0.0803	0.2869	1.0000							
PerSelfEp10	0.0358	-0.0449	0.0098	-0.0779	-0.0599	0.1547	-0.2496	1.0000						
PerManufa10	0.0973	-0.2411	-0.2854	-0.1662	0.1688	0.0744	0.5535	-0.2734	1.0000					
LnPerAgri10	0.1453	-0.3027	-0.3427	-0.4853	0.2845	-0.0724	-0.2104	0.3666	-0.1418	1.0000				
LnMHV10	-0.1696	0.4006	0.5765	0.3677	-0.4090	-0.1563	-0.1501	0.3364	-0.3020	-0.0822	1.0000			
MedEar10	-0.1891	0.5131	0.4706	0.5111	-0.3435	-0.1599	0.1082	-0.1465	-0.0421	-0.3505	0.5672	1.0000		
AveFLFPR0610	0.0949	0.3738	0.5395	0.1839	-0.1078	-0.4669	0.0892	-0.2565	0.0524	-0.1867	0.2711	0.4727	1.0000	
MHVChan~0610	0.1945	-0.0227	-0.0323	-0.2859	0.3189	-0.1970	-0.0831	-0.1989	0.0968	0.0735	-0.3859	-0.1267	0.1453	1.0000

4.2 Data for Question Two and Model II

Table 4 Variable introduction for model II[5]

Category	Variable	Meaning or formula	Expect Sign
Dependent variable	LnCCchange	Growth rate of the Creative Class: (ln (Creative Class 15) – ln (Creative Class10))	NA
Talent	PCC10	Percentage of the Creative Class in 2010	-
Talent	PerArtIn10	Percentage of employment in art relevant industries in 2010	+
Technology	PerHighTech10	Percentage of high-tech employment in 2010	+
Technology	LnPatentPC10	Log transformed patent per capita in 2010	+
Tolerance	PerVoteDe08	Percentage of votes went to Democratic party in 2008 election in State level	+
Tolerance	PerFBP0610	Averaged percentage of foreign-born population from 2006 to 2010	+
Place Making	lnWLRatio	Log transformed water versus land ratio for entire MSA area	+
Place Making	LnPerPT	Log transformed percentage of commuting by public transits	+
Place Making	LnPopDensity10	Log transformed average population density for entire MSA area in 2010	+
Controlling variable	LnTotPop10	Log transformed total population in 2010	+
Controlling variable	PerEdu10	The percentage of the population over 25 with one bachelor's degree or higher in 2010	+
Controlling variable	PerBla10	Percentage of African American population in 2010	NA
Controlling variable	Perover65	Percentage of population over 65-year-old	-
Controlling variable	MeanJanTemp100Y	The 100-year average value of mean temperature in January	+
Controlling variable	COL10	The cost of living index in 2010	-

[5] Detailed data sources are provided in appendix

Controlling variable	LnMHV10	Log transformed median house value in 2010	+
Controlling variable	LnMHV10_2	Log transformed square median house value in 2010	-
Controlling variable	PerPrivaSect10	Percentage of employment in private firms in 2010	+
Controlling variable	CUnEmRate0710	Change of unemployment rate from 2007 to 2010	-

Table 5 Statistical summary for model II

Variable	Obs	Mean	Std. Dev.	Min	Max
LnCCchange	330	.0863079	.1137257	-.4661289	.6938502
PCC10	330	27.1442	4.675922	13.27607	45.48859
PerArtIn10	330	9.037879	2.28582	5.9	28.4
PerHighTe~10	330	7.311236	3.367464	1.815188	24.56846
LnPatentPC10	330	-7.285764	1.247729	-13.61179	-.982274
PerVoteDe08	330	50.4697	7.594631	33	63
PerFBP0610	330	6.051435	3.741903	.3376278	20.25316
lnWLRatio	330	-3.686341	1.625989	-8.402441	.6546453
LnPerPT	330	-4.629804	.9717346	-6.907755	-1.187443
LnPopDens~10	330	5.230679	.8993317	1.9768	7.946614
LnTotPop10	330	5.520566	.4662259	4.873774	7.276921
PerEdu10	330	25.32212	8.034664	10.9	57.5
PerBla10	330	11.12061	11.04462	.3	52.1
Perover65	330	13.27545	3.207946	6.4	34.1
MeanJan~100Y	330	33.94606	12.77404	-7.9	64.2
COL10	330	3.313125	.5248883	1.913642	4.700145
LnMHV10	330	11.9554	.3662729	11.20095	13.35569
PerPrivaS~10	330	77.46879	5.154273	60.5	86.6
CUnEmRa~0710	330	.7250295	.4318292	-.2195122	2.340425

Table 6 Correlation matrix for model II

	LnCCch~e	PCC10	PerA~n10	PerHig~0	LnPat~10	PerVot~8	PerFBP~0	lnWLRa~o	LnPerPT	LnPop~10	LnTotP~0	PerEdu10	PerBla10	Perov~65	Mea~100Y	COL10	LnMHV10	PerP~t10	CUn~0710
LnCCchange	1.0000																		
PCC10	-0.1015	1.0000																	
PerArtIn10	0.1493	-0.1260	1.0000																
PerHighTe~10	0.1708	0.7044	0.0238	1.0000															
LnPatentPC10	0.1143	0.2996	0.0202	0.2486	1.0000														
PerVoteDe08	-0.1225	0.1842	0.0008	0.1047	0.1339	1.0000													
PerFBP0610	-0.1761	-0.3715	-0.0449	-0.4461	-0.1563	-0.1842	1.0000												
lnWLRatio	0.0027	-0.0532	0.1340	0.1196	0.0586	0.1446	-0.1619	1.0000											
LnPerPT	0.1045	0.5252	0.1494	0.5125	0.2709	0.3774	-0.4763	0.1855	1.0000										
LnPopDens~10	0.0193	0.2657	-0.0374	0.3638	0.1810	0.2870	-0.5111	0.4306	0.3888	1.0000									
LnTotPop10	0.1249	0.3892	0.0186	0.5540	0.1249	0.1357	-0.7585	0.2288	0.5392	0.6384	1.0000								
PerEdu10	0.2087	0.7342	0.1201	0.6907	0.4606	0.1213	-0.3735	0.0322	0.6079	0.2430	0.3655	1.0000							
PerBla10	-0.0658	0.0710	-0.0116	0.0449	-0.1696	-0.2218	-0.0446	0.1723	-0.0498	0.2246	0.1679	-0.0754	1.0000						
Perover65	-0.1518	-0.3547	0.1155	-0.2798	0.0485	0.1379	0.2110	0.1527	-0.2412	0.0308	-0.1999	-0.2665	-0.1404	1.0000					
MeanJan~100Y	0.0191	-0.1393	0.1820	0.0142	-0.2708	-0.2433	-0.2309	0.1679	-0.1815	0.1611	0.1597	-0.2204	0.4002	0.1143	1.0000				
COL10	-0.1938	-0.0314	-0.3834	-0.1601	0.0707	-0.1216	0.3347	-0.1423	-0.1935	-0.0808	-0.1551	-0.1471	-0.0249	0.0865	-0.5296	1.0000			
LnMHV10	0.2516	0.4006	0.1807	0.5335	0.2173	0.3703	-0.4090	0.1803	0.5657	0.2020	0.3677	0.5765	-0.2192	-0.1563	-0.0309	-0.4792	1.0000		
PerPrivaS~10	0.1312	-0.2863	-0.0836	-0.1401	0.1916	0.0465	-0.0803	0.1422	-0.0669	0.3187	0.2333	-0.1558	-0.0855	0.2869	-0.2251	0.3587	-0.1501	1.0000	
CUnEmRa~0710	0.1215	-0.0414	0.2108	0.0493	0.1014	-0.0665	-0.0954	0.0738	0.0014	-0.0232	0.0582	0.0554	-0.0730	0.1652	0.2220	-0.2895	0.2747	0.0430	1.0000

CHAPER 5. MODEL CONSTRUCTION AND ANALYSIS

5.1 Model I and Results Interpretation

5.1.1 Model I Construction

Model I constructed below is to answer the first question for this thesis, and corresponds to the data introduction in 4.1. Given the model is subject to a heteroscedasticity problem, OLS estimator is implemented with robust standard errors (Fig 1)

$$LnMedWChange = \beta_0 + \beta_1 * PCC10 + \beta_2 * PerEdu10 + \beta_3 * LnTotPop10 + \beta_4 * PerFBP0610 + \beta_5 * Perover65 + \beta_6 * PerPrivaSect10 + \beta_7 * PerSelfEp10 + \beta_8 * PerManufa10 + \beta_9 * LnPerAgri10 + \beta_{10} * LnMHV10 + \beta_{11} * MedEar10 + \beta_{12} * AveFLFPR0610 + \beta_{13} * MHVChange0610 + \varepsilon$$

5.1.2 Model I Result Analysis and Interpretation

Figure 1 Model I result with robust standard error

Linear regression

Number of obs	=	330
F(13, 316)	=	7.07
Prob > F	=	0.0000
R-squared	=	0.2063
Root MSE	=	.05925

LnMedWChange	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
PCC10	.0011711	.0013144	0.89	0.374	-.001415	.0037573
PerEdu10	.0014035	.0009457	1.48	0.139	-.0004572	.0032642
LnTotPop10	.0280172	.0122811	2.28	0.023	.0038541	.0521802
PerFBP0610	.0022218	.0015135	1.47	0.143	-.000756	.0051996
Perover65	.0008904	.0013992	0.64	0.525	-.0018627	.0036434
PerPrivaSect10	.0035448	.0011257	3.15	0.002	.00133	.0057595
PerSelfEp10	.0047627	.0028311	1.68	0.093	-.0008074	.0103328
PerManufa10	.0001611	.0008476	0.19	0.849	-.0015067	.0018288
LnPerAgri10	.0165896	.0055537	2.99	0.003	.0056627	.0275166
LnMHV10	-.0187556	.0148465	-1.26	0.207	-.047966	.0104548
MedEar10	-4.93e-06	1.57e-06	-3.15	0.002	-8.01e-06	-1.85e-06
AveFLFPR0610	.0021847	.0010891	2.01	0.046	.0000419	.0043275
MHVChange0610	.000553	.0002805	1.97	0.050	1.16e-06	.0011048
_cons	-.2484934	.1986113	-1.25	0.212	-.639261	.1422741

Figure 2 The result of omitted variable test for model I

```
Ramsey RESET test using powers of the fitted values of LnMedWChange
       Ho:  model has no omitted variables
                  F(3, 313) =      1.91
                   Prob > F =      0.1279
```

Figure 3 The result of VIF test for model I

Variable	VIF	1/VIF
LnTotPop10	4.55	0.219896
PerEdu10	4.32	0.231399
LnMHV10	3.44	0.290578
PCC10	3.24	0.309012
MedEar10	2.96	0.337661
PerFBP0610	2.76	0.362388
PerPrivaS~10	2.74	0.364689
AveFLFPR0610	2.48	0.403430
Perover65	2.25	0.443865
PerManufa10	2.15	0.465237
LnPerAgri10	2.10	0.475713
PerSelfEp10	1.78	0.561531
MHVChan~0610	1.52	0.657040
Mean VIF	2.79	

The model results pass both omitted variable (Fig 2) and VIF (Fig 3) tests. The Z-score for Global Moran's I under "Contiguity, Edges and Corners" weighting matrix is 1.026 (p-value is 0.304), and the Z-score under "Inverse Distance" is 1.433 (p-value is 0.1517). Both of the results fail to reject the null hypothesis that residuals are spatial randomly distributed. The diagnoses on residuals and spatial autocorrelations are provided in appendix.

Fail to reject the null hypothesis one

Recap the null hypothesis 1: the percentage of Creative Class in MSAs is not significant to explain the variance of regional wage growth, along with education attainment and other economic characteristic variables in the model. Therefore, the regression results fail to reject the null hypothesis.

Interpretation for significant variables

From the regression result, the percentage of the Creative Class fails to significantly explain regional wage growth rate, with appearance of other significant variables. The estimated coefficients for seven variables are significant at 90% confidence level: total population, percentage of private firm employment, percentage of self-employment population, percentage of agriculture industry employment, median earnings in the base year, average female labor force participation rate before the base year, change of median house value before the base year. In addition, the education attainment (PerEdu10) turns out to be not statistically significant at 0.1 level based on Figure 1, it is only significant on the margin.

An extra F-test to refine model I's result

However, the insignificance of education attainment at 0.1 level (Fig 1) may result from multicollinearities based on the result of VIF (Fig 3). Therefore, an F-test on PCC10 and PerEdu10 is performed to verify whether these two variables are statistically significant to explain regional wage growth rate. Thus, the null hypothesis for the F-test is that the coefficients of PCC10 and PerEdu10 are jointly to be zero ($\beta_1= \beta_2=0$).

The restricted model excluding PCC10 and PerEdu10 has the result shown by Fig 4. The residual sum of squares for the restricted (Fig 4) and unrestricted (Fig 1) models are 1.1411 and 1.1095 respectively. The F value is calculated as 4.5096 based on the two models and it is larger than the F critical value 3.0243 given the degree of freedom in the unrestricted model. Meanwhile, the p value is 0.01171959, smaller than 0.05. Therefore, the result of F-test can reject the null hypothesis that β_1 and β_2 are both equal to zero. This F test result complies with many former studies' conclusions (Glaeser 2005; Rausch and Negrey 2006; Donegan et al. 2008; Wedemeier 2012), and shows that the education attainment should still be one of the focal points for policy makers to raise regional wage levels.

Figure 4 The restricted model for the F-test

Linear regression						
				Number of obs	=	330
				F(11, 318)	=	6.94
				Prob > F	=	0.0000
				R-squared	=	0.1837
				Root MSE	=	.0599

LnMedWChange	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
LnTotPop10	.0271906	.012584	2.16	0.031	.0024321	.0519491
PerFBP0610	.0014403	.0014483	0.99	0.321	-.0014092	.0042897
Perover65	.0009252	.0013779	0.67	0.502	-.0017858	.0036361
PerPrivaSect10	.0029712	.0010707	2.78	0.006	.0008647	.0050778
PerSelfEp10	.0048913	.0028586	1.71	0.088	-.0007329	.0105155
PerManufa10	-.0001832	.0008045	-0.23	0.820	-.001766	.0013996
LnPerAgri10	.0117277	.0055461	2.11	0.035	.000816	.0226395
LnMHV10	-.0054747	.0160421	-0.34	0.733	-.0370369	.0260874
MedEar10	-4.68e-06	1.60e-06	-2.93	0.004	-7.82e-06	-1.53e-06
AveFLFPR0610	.0033565	.0010139	3.31	0.001	.0013617	.0053513
MHVChange0610	.0006551	.000271	2.42	0.016	.0001219	.0011882
_cons	-.3581971	.1947114	-1.84	0.067	-.7412824	.0248883

By synthesizing the results of model I and F-test, the education attainment, economic performance before the base year, and some economic characteristics in the base year should be focal points for policy makers and city officials, if they aim to raise regional wage growth rate. The interpretation for each significant variable in Fig 1 is listed below.

LnTotPop10: One percent increase in the total population is positively correlated with 0.0280172 percent change in the growth rate of regional median wage, ceteris paribus.

PerPrivaSect10: One percentage increase in the share of private firms' employment is positively correlated with 0.0035448 percent change in the growth rate of regional median wage, ceteris paribus.

PerSelfEp10: One percentage increase in the share of self-employed population is positively correlated with 0.0047627 percent change in the growth rate of regional median wage, ceteris paribus.

LnPerAgri10: One percent increase in the share of agriculture employment is positively correlated with 0.0165896 percent change in the growth rate of regional median wage, ceteris paribus.

AveFLFPR0610: One percentage increase in the share of 5-year average female labor participation rate (2006-2010) is positively associated with 0.0021847 percent change in the growth rate of regional median wage, ceteris paribus.

MHVChange0610: One percent increase in the 5-year growth rate of median house value (2006-2010) is positively correlated with 0.000553 percent change in the growth rate of regional median wage, ceteris paribus.

Model results discussions

Among these variables, four of them representing the base year's economic structure and industry mix are shown to be significantly impactful. Frist, the positive association between the wage growth rate and total population size reveals the importance of urbanization economies of scale in promoting regional economic development. Lager regions observe faster wage growths. Because they enjoy strong inter-industry knowledge spillovers and tend to capture more growth opportunities within the regions. Second, the positive association between the private sector share and the wage growth are aligned with Jacobs's (1961) and Pettinger's (2017) arguments. Third, a higher value of self-employment rate during and after the recession is proved to be a way to avoid the growth of unemployment rate, making regional economy more resilient during and after the hardship from both individuals' and administrators' perspectives (Beckhusen 2014). This resilient argument is also applicable to the last variable, the percentage of agriculture employment. The positive coefficient for this variable is supported by Ramesha's (2019) argument of recession-proof effects.

The positive signs of the last two estimated coefficients (AveFLFPR0610 and MHVChange0610) are also supported by literature. The median house value change before 2010 to some extent reflect a region's economic performances around the recession period. For example, Midland, TX metro, which has the highest wage growth rate after 2010 observed the highest home price change between 2006 to 2008 among all metros studied by Abel and Peitz (2010). As for the average percentage of female labor participation rate, the positive association is supported by Drennan (2005) and Weinstein (2015) -- the more female labors in the markets, the better economic performances.

5.2. Model II and Results Interpretation

Model II is to answer the second question for this thesis with data introduction in 4.2 section, it is constructed by the equation below. Given a heteroscedasticity problem in the model, robust standard error is applied for the OLS regression (Fig 5). The model II passes both the omitted variable (Fig 6) and VIF (Fig 7) tests. Residual and spatial autocorrelation diagnosis results are provided in the appendix.

5.2.1 Model II Construction

$$\begin{aligned}LnCCchange &= \beta_0 + \beta_1{*}PCC10 + \beta_2{*}PerArtIn10 + \beta_3{*}PerHighTech10 + \beta_4{*}LnPatentPC10 + \\ &\beta_5{*}PerVoteDe08 + \beta_6{*}PerFBP0610 + \beta_7{*}lnWLRatio + \beta_8{*}LnPerPT + \beta_9{*}LnPopDensity10 + \\ &\beta_{10}{*}LnTotPop10 + \beta_{11}{*}PerEdu10 + \beta_{12}{*}PerBla10 + \beta_{13}{*}Perover65 + \beta_{14}{*}MeanJanTemp100Y + \\ &\beta_{15}{*}COL10 + \beta_{16}{*}LnMHV10 + \beta_{17}{*}LnMHV10\_2 + \beta_{18}{*}PerPrivaSect10 + \beta_{19}{*}CUnEmRate0710 + \varepsilon\end{aligned}$$

5.2.2 Model II Result Analysis and Interpretation

Figure 5 Model II result with robust standard error

Linear regression

Number of obs	=	330
F(19, 310)	=	5.67
Prob > F	=	0.0000
R-squared	=	0.3340
Root MSE	=	.09561

LnCCchange	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
PCC10	-.014303	.0031032	-4.61	0.000	-.020409	-.008197
PerArtIn10	-.000664	.003943	-0.17	0.866	-.0084225	.0070945
PerHighTech10	.0094728	.0031932	2.97	0.003	.0031897	.015756
LnPatentPC10	.0022826	.004576	0.50	0.618	-.0067213	.0112865
PerVoteDe08	-.0016548	.0009767	-1.69	0.091	-.0035766	.000267
PerFBP0610	-.0031198	.0028887	-1.08	0.281	-.0088038	.0025642
lnWLRatio	-.0060273	.0037227	-1.62	0.106	-.0133522	.0012976
LnPerPT	.0021611	.0092409	0.23	0.815	-.0160218	.0203441
LnPopDensity10	-.0008198	.0095677	-0.09	0.932	-.0196457	.0180062
LnTotPop10	-.0354888	.0256046	-1.39	0.167	-.0858696	.014892
PerEdu10	.0046934	.0015739	2.98	0.003	.0015965	.0077903
PerBla10	.0001624	.000539	0.30	0.763	-.0008983	.001223
Perover65	-.0066169	.0019974	-3.31	0.001	-.0105472	-.0026867
MeanJanTemp100Y	.000343	.0007971	0.43	0.667	-.0012254	.0019114
COL10	-.0235754	.0178462	-1.32	0.187	-.0586904	.0115396
LnMHV10	1.590432	.6260812	2.54	0.012	.3585255	2.822338
LnMHV10_2	-.0634983	.0257781	-2.46	0.014	-.1142205	-.012776
PerPrivaSect10	.0047841	.0016005	2.99	0.003	.001635	.0079333
CUnEmRate0710	-.0027699	.0144819	-0.19	0.848	-.0312651	.0257253
_cons	-9.546489	3.781605	-2.52	0.012	-16.98735	-2.10563

Figure 6 The result of omitted variable test for model II

```
. ovtest

Ramsey RESET test using powers of the fitted values of LnCCchange
       Ho:  model has no omitted variables
                  F(3, 307) =      0.81
                   Prob > F =      0.4864
```

Figure 7 The result of VIF test for model II

```
. vif
```

Variable	VIF	1/VIF
LnMHV10	2195.86	0.000455
LnMHV10_2	2190.16	0.000457
PerEdu10	4.36	0.229278
LnTotPop10	4.28	0.233798
PCC10	3.92	0.255236
MeanJan~100Y	3.28	0.304885
PerFBP0610	3.17	0.315640
PerHighTe~10	3.13	0.319184
COL10	2.90	0.344529
LnPopDens~10	2.68	0.372676
LnPerPT	2.65	0.377712
PerPrivaS~10	2.29	0.435808
PerVoteDe08	1.90	0.526045
Perover65	1.64	0.608901
PerBla10	1.63	0.613039
LnPatentPC10	1.53	0.655119
lnWLRatio	1.42	0.704282
PerArtIn10	1.41	0.708928
CUnEmRa~0710	1.35	0.738858
Mean VIF	233.14	

Model II also passes the omitted variable (Fig 6) and VIF (Fig 7) tests. The Z-score for Global Moran's I is 1.163 (P-value is 0.244) under the "Contiguity, Edges and Corners" weighting matrix, and Z-score is 0.522 (p-value is 0.602) under the "Inverse Distance" weighting matrix. Similar to model I, both of the spatial autocorrelation results for model II fail to reject the null hypothesis that residuals are spatial randomly distributed. Diagnoses on residuals and spatial autocorrelations are provided in the appendix.

Fail to reject the hypothesis 2

Recap of hypothesis 2: "3T" plus "place-making" factors defined by Richard Florida are not positively significant to explain the growth rate of the Creative Class across MSAs, controlling the education attainment and other economic characteristics variables in the model.

Given that three out of night variables derived from Florida's theory are significant, and only one is positively significant (PerHighTech10), the model results generally fail to reject this null hypothesis.

Interpretation for significant variables

From the regression results, the percentage of the Creative Class is negatively correlated with its following growth, which is generally against the divergence trend of human capital argued by Berry and Glaeser (2005), and not aligned with Florida's idea of creatives' divergence (2008). However, the main evidence these scholars use is during and before 1990s, a totally different economic context compared to the after-recession era. Also, Berry and Glaser's research shows a continuously decreasing growth rate of regional human capital from 1970s to 1990s, indicating the divergence trend has become weaker over time. Therefore, it is plausible that the Creative Class, which is 70% overlapped with Berry and Glaser's human capital indicator, goes through a convergence trend after 2010.

The following paragraphs discuss findings in other variables that are grouped into "3T", "place-making", and controlling variables, following the same logic in 2.2.2 section of literature review.

For the "3T" factors under Florida's original definition, only the estimated parameter for the percentage of high-tech industry employment turns out to be positively significant. As a replaced "Tolerance" indicator, the percentage of vote for Democratic Party in 2008 selection is significant. However, the sign is opposite to Florida's theory, indicating a reverse trend of spatial migration. There are two reasons to account for this unexpected negative association: one is the economic crisis impacted the blue regions more, since they have been more open and aggressive; the other reason may lie in the measurement errors of this variable—the shares of Democratic vote are measured in the State levels rather than core-counties in metropolitan areas.

For the "place-making" variables, only water-land ratio for MSA is significant only on the margin. Its negative sign is against Florida's theory but supported by McGranahan and Wojan's reseasrch (2007), where water area is not significant and mountains regions are significantly favored. The rest of significant coefficients are for the controlling variables. They will be discussed and synthesized after the variable interpretation below.

PCC10: one percentage increase in the initial share of the Creative Class among all employment is negatively correlated with 0.014303 percent change in regional growth rate of the Creative Class, ceteris paribus.

PerHighTech10: one percentage increase in the high-tech industry employment share is positively associated with 0.0094728 percent change in regional growth rate of the Creative Class, ceteris paribus.

PerVoteDe08: one percentage increase in the share of Democratic vote in 2008 election is negatively associated with 0.0016548 percent change in regional growth rate of the Creative Class, ceteris paribus.

PerEdu10: one percentage increase in the share of population over 25-year-old with a bachelor's degree is positively associated with 0.0046934 percent change in regional growth rate of the Creative Class, ceteris paribus.

Perover65: one percentage increase in the share of population over 65-year-old is negatively associated with 0.0066169 percent change in regional growth rate of the Creative Class, ceteris paribus.

LnMHV10 (LnMHV_2): the growth rate of the Creative Class is positively correlated with the increase of median house value, and it reaches the highest growth rate when median house value equals to 274580 (e^12.523), and then the growth rate has a negative correlation with the increase of median house value after the turning point.

PerPrivaSect10: one percentage increase in share of private firm employed population is positively associated with 0.0047841 percent change in regional growth rate of the Creative Class, ceteris paribus.

There are two important findings drawn from the interpretations above. First, it comes out that the migration patterns of the Creative Class reversed -- an obvious convergence trend is empirically proved, which is opposite to former studies advocating for divergence trends around and before 1990s (Berry and Glaeser 2005, Florida et al. 2008). Second, the attractive factors to the Creative Class proposed by Florida have differentiated validities to current phenomena. Among the "3T" factors, the technology indicator is far more attractive than the "talent" and "tolerance" indicators for the Creative Class. For the "place-making" factors, only the water-land ratio is proved to be explanatorily significant in this study.

In addition, all variables in fig 4 are regressed against total population change rate for the same period, with an aim to form a pure comparison. The different locational preferences between the Creative Class and general population is shown in table 7 below. Generally, the Creative Class growth rate shares similar explanatory factors with general population growth rate during the after-recession period. Therefore, this comparison implies that the growth of the Creative Class in one region is very likely due to the overall growth of total population in that region.

Table 7 Locational preference between the Creative Class and general population

Dependent variable Independent variables	LnCCchange	LnTotPopChange
PCC10	(-0.14303) ***	(-0.0015892) **
PerHighTech10	(0.0094728) ***	(0.0016471) **
PerVoteDe08	(-0.0016548) *	(-0.0009349) ***
PerEdu10	(0.0046934) **	(0.0024838) **
PerBla10	--	(-0.0010462) ***
PerPrivateSect10	(0.0047841) **	(0.0015853) ***
MeanJanTemp100Y	--	(0.0015269) ***
LnMHV10	(1.590432) **	(-0.9532028) ***
LnMHV10_2	(-0.0634983) **	(0.0388723) ***
Perover65	(-0.0066169) ***	(-0.0034458) ***

Robust standard error estimated coefficient in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

CHAPER 6. RESEARCH CONCLUSIONS AND LIMITATIONS

This chapter discusses the research conclusions and limitations in an integral rather than separated way for the two models, because the two models both deploy cross-sectional methods, OLS estimators, spatial autocorrelation tests, and share some explanatory variables. In addition, most of the limitations for this thesis are applicable to both.

6.1 Research Conclusions

6.1.1 The after-recession period observes a different phenomenon

The selection of the study periods is influential on research conclusions. The same question might have two reversed answers in different eras. Subsequent studies of Florida's Creative Class theory have examined numerous cases worldwide, with evidence generally from 1980s to 2000s. Most of the studies focusing on the prosperous 1990s generally show some positive economic impacts of the creative population, though with different measurements of economic growth (McGranahan and Wojan 2007; Donegan et al. 2008; Gabe 2011; Möller and Tubadji 2009; Wedemeier 2012). Similarly, for the location preference discussion, the suggested divergent migration patterns of the creative population are only proved with evidence during and before 1990s (Berry and Glaeser 2005; Florida et al. 2008)

However, the results of this thesis describe a different story during the after-recession era--clustering of the Creative Class in an MSA neither increases the wage growth rate nor raises the ensuing growth rate of the group itself, and a convergence trend is proposed. There are several reasons to explain for this disparity from former studies.

First, 2010-2015 is a relative short period. The growth rates of wages and the Creative Class in such a short period are both subject to higher fluctuations, compared to the more stable values often captured in longer time span. Second, the different economic environment during and after the recession period weakens the validity of Florida's theory established ten years' ago. For example, some markets for creative jobs across different MSAs could have been saturated after continuous in-migrations during the prosperous era before the recession, and migration patterns then turned into an overall convergence trend. Therefore, the proposed location preferences for this class might also have changed.

The second argument above is supported by the fact that median and small size MSAs observe faster creatives' growth rates than the big creative metros such as New York and Los Angeles. The top MSAs with the largest Creative Class share are observed to lose this group of population from 2010 to 2015. Table 8 shows the Creative Class has increased by 8.50% as an entire group nationally during the five-year period. However, most of the top twenty Creative Class Metros have experienced declines in the shares of creative population among all their employments.

In table 9, 14 out of 17 top MSAs experienced creative loss from 2010 to 2015. Considering the overall increased share in the country's level, it is reasonable to believe that other non-primary MSAs have witnessed obvious growth in the share of the Creative Class. This empirical evidence to some extent supports the convergence arguments in this thesis.

Table 8 The increase rates of the Creative Class occupations from 2010 to 2015 in the U.S.

Categories of the Creative Class	2010	2015	Increase rate
Computer and Mathematical Occupations	3,283,950	4,005,250	21.96%
Architecture and Engineering Occupations	2,305,530	2,475,390	7.37%
Life, Physical, and Social Science Occupations	1,064,510	1,146,110	7.67%
Education, Training, and Library Occupations	8,457,870	8,542,670	1.00%
Arts, Design, Entertainment, Sports, and Media Occupations	1,716,640	1,843,600	7.40%
Management Occupations	6,022,860	6,936,990	15.18%
Sales Managers	319,300	364,750	14.23%
Business and Financial Operations Occupations	6,090,910	7,032,560	15.46%
Legal Occupations	992,650	1,062,370	7.02%
Healthcare Practitioners and Technical Occupations	7,346,580	8,021,800	9.19%
Total Creative Class Population in the U.S.	**127,097,160**	**137,896,660**	**8.50%**

Source: US Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics (OES) survey (2010, 2015). Analysis by author.

Table 9 The top 20 Creative Class MSAs based on 2010 and their changed shares in 2015

Metropolitan Statistical Areas	PCC10	PCC15	Change
Durham, NC	48.4%	44.7%	Decrease
San Jose-Sunnyvale-Santa Clara, CA	46.9%	46.9%	Unchanged

Washington-Arlington-Alexandria, DC-VA-MD-WV	46.8%	44.3%	Decrease
Ithaca, NY	44.6%	41.1%	Decrease
Boulder, CO	44.4%	42.38%	Decrease
Trenton-Ewing, NJ	42.9%	41.9%	Decrease
Huntsville, AL	42.7%	38.51%	Decrease
Corvallis, OR	41.7%	43.44%	Increase
Boston-Cambridge-Quincy, MA-NH	41.6%	36.64%	Decrease
Ann Arbor, Mi	41.3%	44.3%	Increase
Tallahassee, FL	40.5%	38.92%	Decrease
Rochester, MN	40.0%	32.35%	Decrease
Charlottesville, VA	39.7%	38.12%	Decrease
Hartford-West Hartford-East Hartford, CT	39.7%	NA	NA
Bridgeport-Stamford-Norwalk, CT	39.5%	NA	NA
San Francisco-Okland-Fremont, CA	39.4%	38.2%	Decrease
Gainesville, FL	39.3%	38.9%	Decrease
Olympia, WA	38.9%	30.35%	Decrease
Madison, WI	38.3%	36.87%	Decrease
Burlington-South Burlington, VT	37.9%	NA	NA

Source: Column "PCC10" is derived from Florida's work (Florida 2014, p. 207); column "PCC15" is from data provided by the US Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics (OES) survey (2015). Column "Change" is edited as the comparison result. Analysis by author.

6.1.2 General education attainments and economic characteristics matter more

From the results of the first and the second models, it is obvious that many controlling variables outweigh the factors that were proposed and promoted by Florida and his followers in terms of the Creative Class's economic impacts and its growth rates.

Going back to the debate on whether occupational-measured Creative Class indicator is better than the education attainment indicator to predict the discussed dependent variables, the results from this thesis support the idea that education attainment level better accounts for the economic development and the attractiveness of a region. Thus, it is reasonable to suggest that general inter-industry knowledge spillovers are more important than intra-industry knowledge spillovers. Therefore, the implication for policy makers and government agencies is to invest more resources in general education programs instead of offering subsidies to attract certain groups of occupations.

Comparing the creative favored factors ("3T" and "place-making") with general economic characteristics, the results of this thesis reveal that some general economic characteristics are far more important both for regional economic growths and creatives' migration patterns. For economic development purposes, the industry mix (agriculture, manufacturing, and service), the share of private and public employment, the gender structure of the labor force are all basic but critical factors to consider. Policy makers and government agencies should prioritize these macro level factors by helping to foster diversified industries to bring in more jobs, helping to create fair political and legal environments for private sectors and young people to thrive, and helping to create female-friendly labor markets. Generally, making a region attractive to everyone is a strategy to stimulate the local economy and lure the creatives.

However, a caveat needs to be mentioned—though the "3T" and "place-making" factors, considered as two groups, are generally less important than they are suggested when controlling for other factors, the individual indicators within these groups have discrepant effects. Some "technology" and "tolerance" indicators outweigh the "talent" indicators when they are individually examined as attractive factors for potential creative in-migrants. Similarly, the individual indicators within the "place-making" group also show differentiated effects for the same dependent variable.

6.2 Research Limitations and Further Considerations

After discussion of the major conclusions, three research limitations relevant to the conclusions are presented below. Furthermore, some remedy suggestions are provided for future research purpose, with the hope to improve the results.

6.2.1 The problem of short-term fluctuation

As concluded in section 6.1.1, the five years' after-recession period captures a limited piece of information in terms of the economic impacts and the migration patterns of the Creative Class. For future research, a longer study period is suggested when data are available. The short time span may lead to high-leverage residuals and misleading results. For example, the largest residuals in the wage growth model is Midland MSA in Texas, a place that ranked first in the after-recession wage growth list due to a taking-off in its oil fracking industry from 2008 to 2015 (Maciag 2013). However, such an extremely high wage growth rate derived from oil-industry boom is unsustainable. As reported by a government report: "as the state economy slowed notably in 2015–2016 due to collapsing oil prices and related exploration activities, metros such as Dallas and Austin with a more diversified industrial base offset weakness Midland and other energy-producing regions" (Federal Reserve Bank of Dallas, 2019). Therefore, by adopting a longer study period, the results of the model will be more universally applicable and be less impacted by some extreme cases.

6.2.2 Data measurement problems

Referring to section 6.1.2, the general insignificances of the "place-making" indicators mentioned in the second conclusion may result from measurement errors. For example, the compact and dense urban environment advocated by Florida (2002b, 2012) and Jacobs (1961) is hard to measure in metropolitan levels, therefore, no data but proxy indicators such as public transit commuting share, and population density for entire metro area can be used. Also, the variable of voting percentage for the Democratic Party in 2008 election is collected in State rather than county levels. More importantly, the growth rates of Creative Class across MSAs can also be affected by people's career changes within a region besides the inter-regional migrations. All these approximations in either independent and or dependent variables may lead to bias against the truth and lower the explanatory power of independent variables. Therefore, it is suggested to find and use more appropriate indicators to replace these approximated ones and compare new results with former conclusions.

6.2.3 Relative low variance explained for model I

Model I has a relatively low R^2, indicating the total variance explained by the model is not in an ideal level. However, the low fit model might be improved if the study period is expanded into a longer term with smoother data, and refine data measurement for variables. Thus, future studies might try to improve the results by fixing the former two limitations.

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Appendix

Data source for model I

Variable	Meaning or formula	Data source
LnMedEarChange	Log transformed growth rate of nominal median wages for all genders (ln (median wage 15)- ln (median wage 10))	American Community Survey 1 year estimate (ACS)
PCC10	Percentage of the Creative Class among all employments in 2010	Occupational Employment Statistics (OES)
PerEdu10	The percentage of the population over 25 with at least one bachelor's degree or higher in 2010	American Community Survey 1 year estimate (ACS)
LnTotPop10	Log transformed total population in 2010	American Community Survey 1 year estimate (ACS)
PerFBP0610	5-year averaged percentage of foreign-born people (from 2006 to 2010)	American Community Survey 1 year estimate (ACS)
Perover65	Percentage of population over 65-year-old	American Community Survey 1 year estimate (ACS)
PerPrivaSect10	Percentage of private sector employment in 2010	American Community Survey 1 year estimate (ACS)
PerSelfEp10	Percentage of self-employed population in 2010	American Community Survey 1 year estimate (ACS)
PerManufa10	Percentage of employment in manufacturing industry in 2010	American Community Survey 1 year estimate (ACS)
LnPerAgri10	Log transformed percentage of employment in agriculture industry in 2010	American Community Survey 1 year estimate (ACS)
LnMHV10	Log transformed median house value in 2010	American Community Survey 1 year estimate (ACS)
MedEar10	Nominal median household earnings (wages and salaries) in 2010	American Community Survey 1 year estimate (ACS)

AveFLFPR0610	5-year averaged female labor force participation rate from 2006 to 2010	American Community Survey 5 year estimate (ACS)
MHVChange0610	Growth rate of median house value from 2006 to 2010: ((MHV10-MHV06)/MHV06)	American Community Survey 1 year estimate (ACS)

Data source for model II

LnCCchange	Growth rate of the Creative Class: (ln (Creative Class 15) – ln (Creative Class10))	Occupational Employment Statistics (OES)
PCC10	Percentage of the Creative Class in 2010	Occupational Employment Statistics (OES)
PerArtIn10	Percentage of employment in art relevant industries in 2010	American Community Survey 1 year estimate (ACS)
PerHighTech10	Percentage of high-tech employment in 2010	American Community Survey 1 year estimate (ACS)
LnPatentPC10	Log transformed patent per capita in 2010	Brookings.edu[6]
PerVoteDe08	Percentage of votes went to Democratic party in 2008 election in State level	US 2008 election result[7]
PerFBP0610	Averaged percentage of foreign-born population from 2006 to 2010	American Community Survey 1 year estimate (ACS)
LnWLRatio	Log transformed water versus land ratio for entire MSA area	American Community Survey 1 year estimate (ACS)
LnPerPT	Log transformed percentage of commuting by public transits	American Community Survey 1 year estimate (ACS)
LnPopDensity10	Log transformed average population density for entire MSA area in 2010	American Community Survey 1 year estimate (ACS)
LnTotPop10	Log transformed total population in 2010	American Community Survey 1 year estimate (ACS)
PerEdu10	The percentage of the population over 25 with one bachelor's degree or higher in 2010	American Community Survey 1 year estimate (ACS)
PerBla10	Percentage of African American population in 2010	American Community Survey 1 year estimate (ACS)

[6] https://www.brookings.edu/interactives/patenting-and-innovation-in-metropolitan-america/
[7] https://docs.google.com/spreadsheets/d/1gLzjUFBk9gtAPfZ-bNZVfFC1zNhGkY_WI_VD_OXHUYI/edit#gid=1

Perover65	Percentage of population over 65-year-old	American Community Survey 1 year estimate (ACS)
MeanJanTemp100Y	The 100-year average value of mean temperature in January	National Center for Environmental Information[8]
COL10	The cost of living index in 2010	American Community Survey 1 year estimate (ACS)
LnMHV10	Log transformed median house value in 2010	American Community Survey 1 year estimate (ACS)
LnMHV10_2	Log transformed square median house value in 2010	American Community Survey 1 year estimate (ACS)
PerPrivaSect10	Percentage of employment in private firms in 2010	American Community Survey 1 year estimate (ACS)
CUnEmRate0710	Change of unemployment rate from 2007 to 2010	American Community Survey 3 year estimate (ACS)

Definition of "3T" factor by Florida (2012)

"Talent" is composed of the share of the creative occupations among all occupations. The creative occupations are made up of ten major occupation categories:

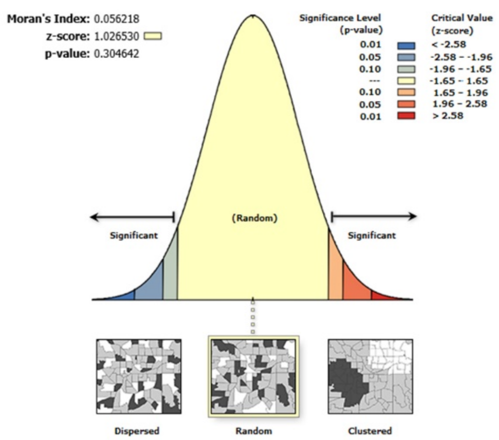
- Computer and mathematical occupations
- Architecture and engineering occupations
- Life, physical, and social science occupations
- Education, training, and library occupations
- Arts, design, entertainment, sports, and media occupations
- Management occupations
- Sales mangers
- Business and financial operations occupations
- Legal occupations
- Healthcare practitioners and technical occupations.

"Technology" is composed of Tech-Pole Index (share of high-tech industry), patent per capita and average annual patent growth. "Tolerance" is composed of the gay index, the melting pot index and foreign-born index.

[8] https://www.ncdc.noaa.gov/cag/divisional/mapping/110/tavg/201001/1/value

Results of Global Moran's I for model I and model II

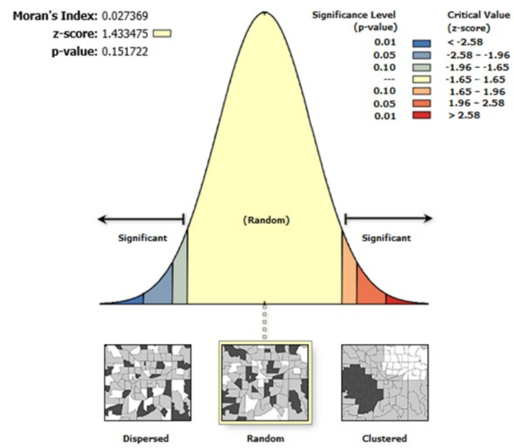
Global Moran's I for Model 1 (Inverse Distance)



Given the z-score of 1.02653019345, the pattern does not appear to be significantly different than random.

Global Moran's I Summary	
Moran's Index:	0.056218
Expected Index:	-0.003058
Variance:	0.003334
z-score:	1.026530
p-value:	0.304642

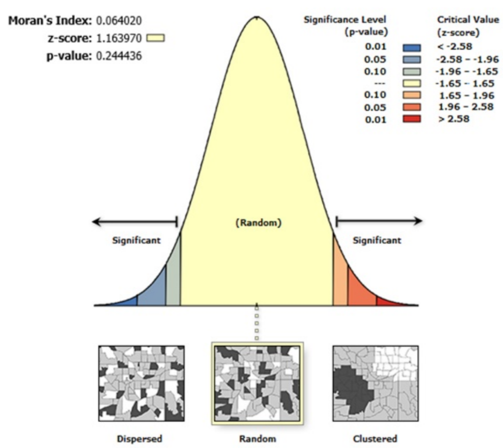
Global Moran's I for Model 1 (Contiguity, Edges, Corners)



Given the z-score of 1.43347467404, the pattern does not appear to be significantly different than random.

Global Moran's I Summary	
Moran's Index:	0.027369
Expected Index:	-0.003058
Variance:	0.000451
z-score:	1.433475
p-value:	0.151722

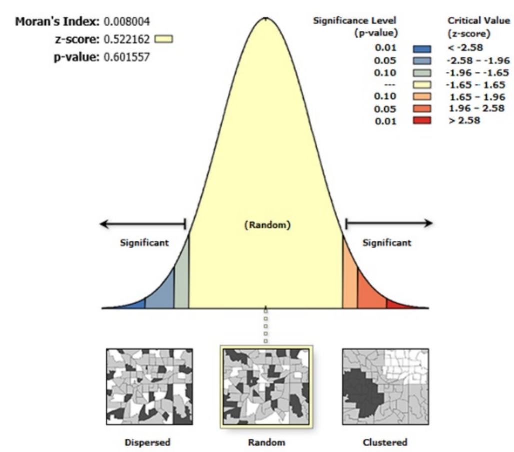
Global Moran's I for Model 2 (Inverse Distance)



Given the z-score of 1.16397009812, the pattern does not appear to be significantly different than random.

Global Moran's I Summary	
Moran's Index:	0.064020
Expected Index:	-0.003058
Variance:	0.003321
z-score:	1.163970
p-value:	0.244436

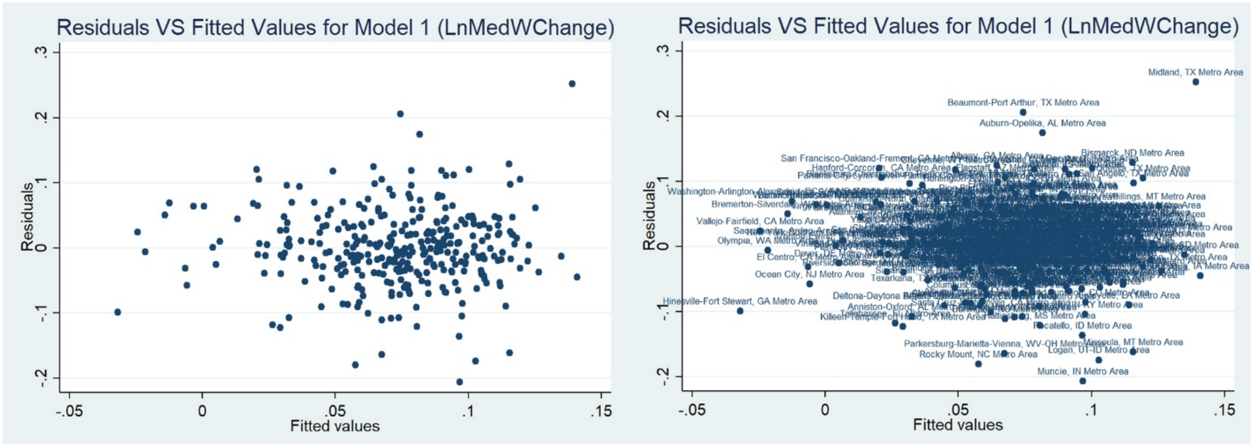
Global Moran's I for Model 2 (Contiguity, Edges, Corners)



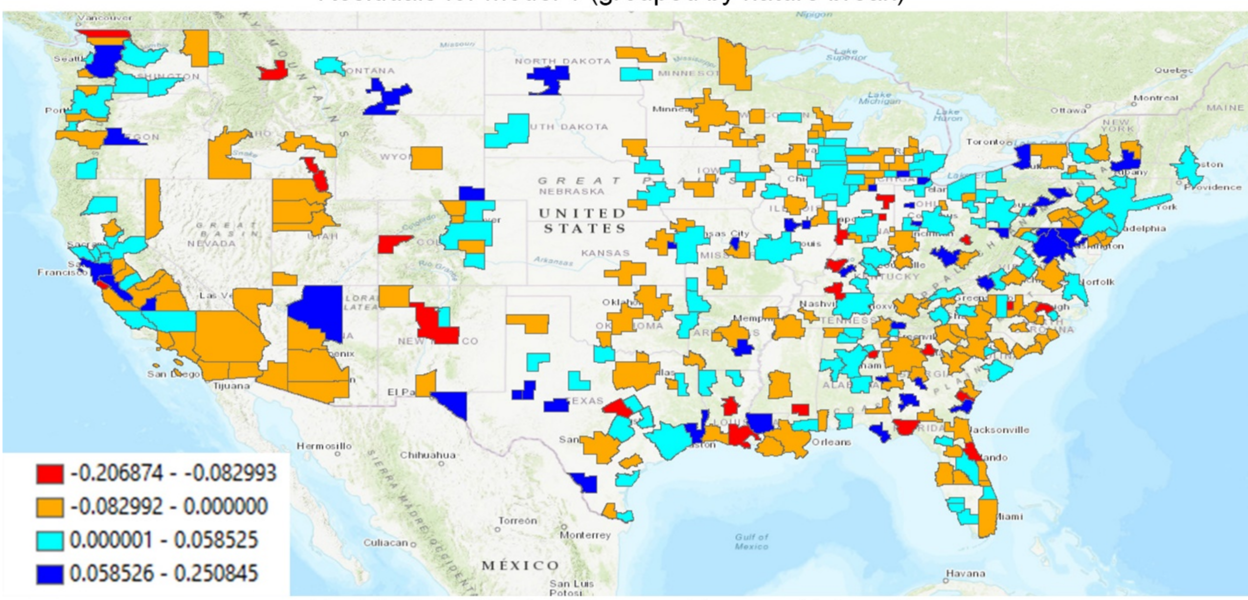
Given the z-score of 0.522162388018, the pattern does not appear to be significantly different than random.

Global Moran's I Summary	
Moran's Index:	0.008004
Expected Index:	-0.003058
Variance:	0.000449
z-score:	0.522162
p-value:	0.601557

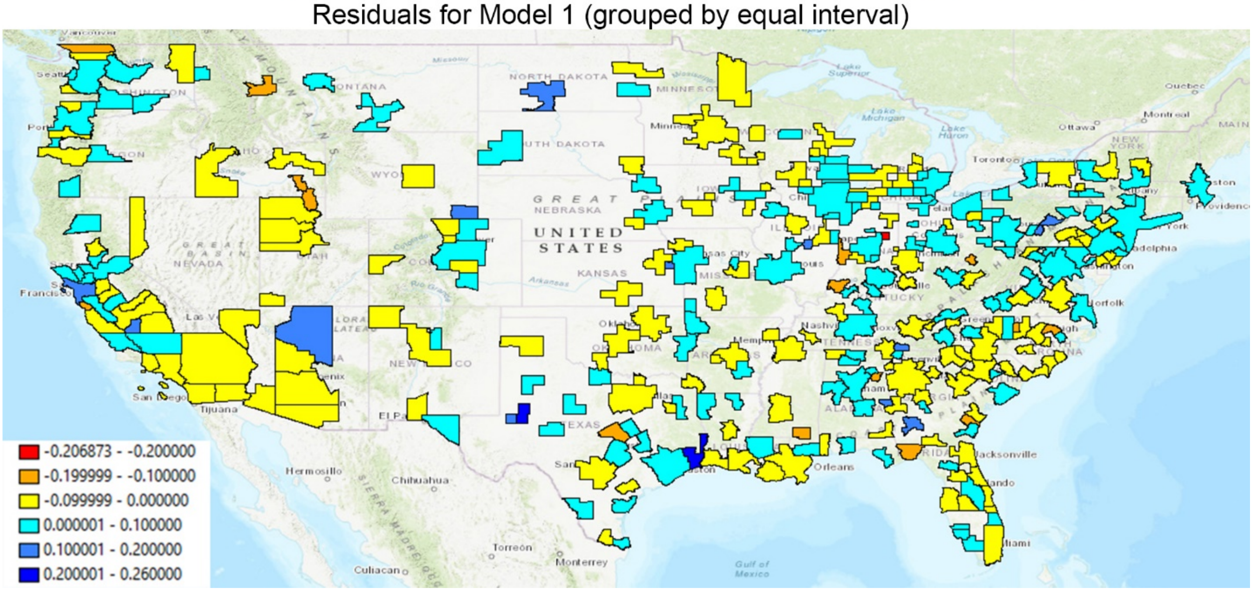
Residuals vs Fitted Value and Residual Spatial Plot for Model I



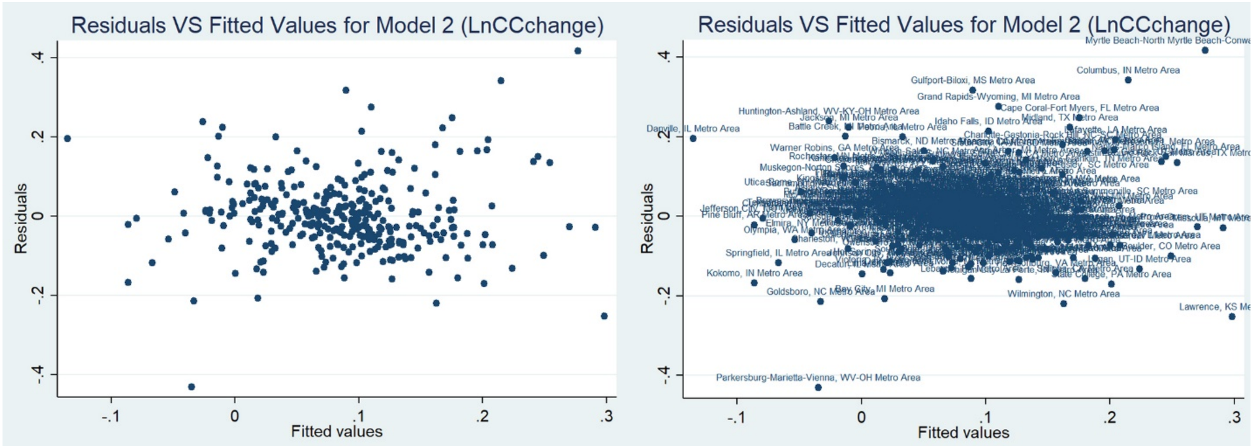
Residuals for Model 1 (grouped by nature break)



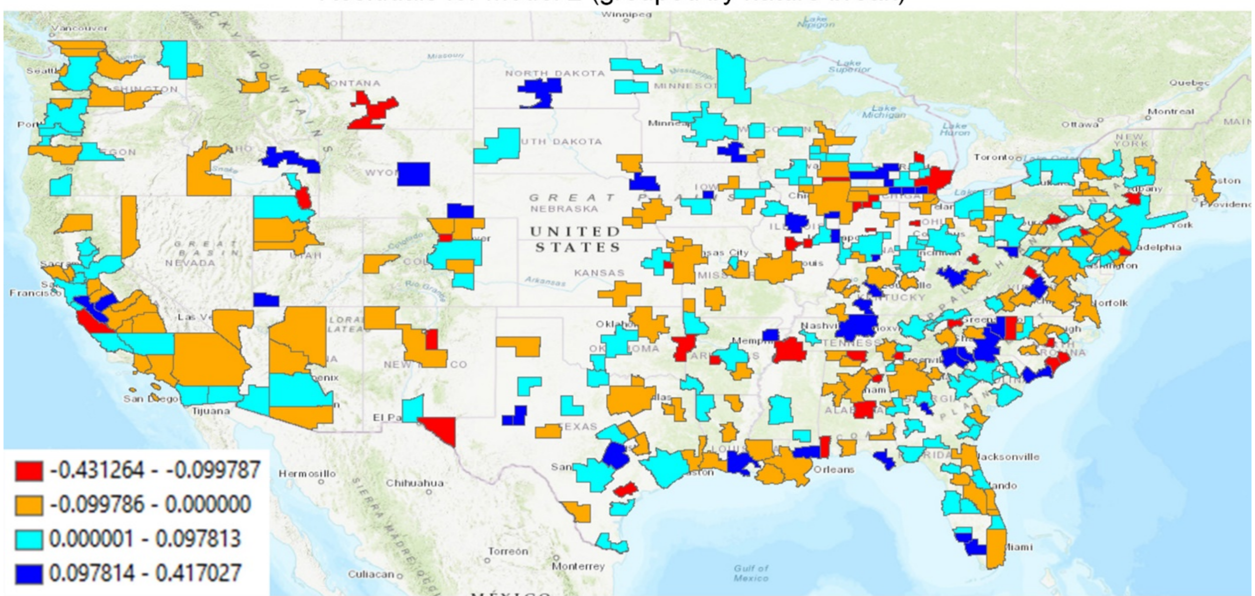
Residuals for Model 1 (grouped by equal interval)



Residuals vs Fitted Value and Residual Spatial Plot for Model II



Residuals for Model 2 (grouped by nature break)



Residuals for Model 2 (grouped by equal interval)